SURFACE LIGHT SOURCE DEVICE AND DISPLAY DEVICE USING THE SAME

Patent Number:	JP8271886
Publication date:	1996-10-18
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Requested Patent:	☐ JP8271886
Application Number:	JP19950070288 19950329
Priority Number(s):	
IPC Classification:	G02F1/1335; F21V8/00; G02B6/00
EC Classification:	
Equivalents:	

Abstract

PURPOSE: To provide a compact surface light source device whose outside dimension is not restricted by a tubular light source by housing the tubular light source in the thickness direction of a light transmission plate.
CONSTITUTION: This light source device is provided with a lamp housing groove 921 formed nearly in parallel with the long side of the light transmission plate 911 in the center part of its back surface, and the tubular light source 951 is housed in the groove 921. The device is shaped to be tapered so that plate thickness may be reduced toward the end of the plate 911 from the groove 921. Then, light source light made incident on the 1st light introducing plane 921a of the plate 911 is propagated in the plate 911 and a part of the light is emitted from the emitting surface of a 1st projection train 913. In the same manner, the light source light made incident on the 2nd light introducing plane 921b of the plate 911 is also propagated in the plate 911 and a part of the light is emitted from the emitting surface of a 2nd projection train 915. The emitted light emitted from the plate 911 is controlled to be diffused light whose angle 13 about 90 deg., and controlled to be the light source light whose condensing angle is 22 deg. and which faces to a liquid crystal panel 101 by a prism sheet 991.

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(19)日本国特許庁（ＪＰ）

(12) **公開特許公報**（Ａ）

(11)特許出願公開番号

特開平8－271886

(43)公開日　平成８年(1996)10月18日

(51)Int.Cl.^{6}		識別記号	庁内整理番号	ＦＩ			技術表示箇所
Ｇ０２Ｆ	1/1335	５３０		Ｇ０２Ｆ	1/1335	５３０	
Ｆ２１Ｖ	8/00			Ｆ２１Ｖ	8/00	Ｄ	
Ｇ０２Ｂ	6/00	３３１		Ｇ０２Ｂ	6/00	３３１	

審査請求　未請求　請求項の数４　ＯＬ　（全 ６ 頁）

(21)出願番号　　特願平7－70288

(22)出願日　　平成７年(1995) ３月29日

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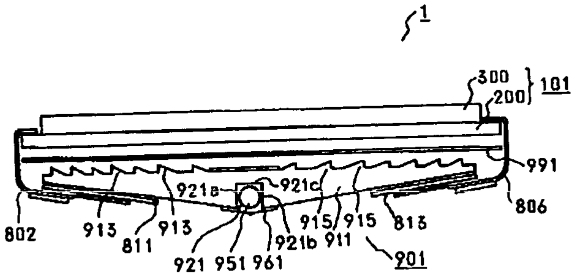
(54)【発明の名称】　面光源装置およびそれを用いた表示装置

(57)【要約】

【構成】　この発明は、管状光源と、管状光源からの光源光を選択的に出射する複数の突起を一主表主表面に含む導光板とを備えた面光源装置であって、導光板は、管状光源を導光板の厚さ方向に収納し、且つ管状光源からの光源光を導光板に導くよう厚さ方向に形成される光導入平面を含む収納部を備えたことを特徴としている。

【効果】　本発明によれば、光利用効率が高く、しかも装置の狭額縁化を達成することができる。



【特許請求の範囲】

【請求項1】　管状光源と、管状光源からの光源光を選択的に出射する複数の突起を一主表面に含む導光板とを備えた面光源装置において、
前記導光板は、前記管状光源を前記導光板の厚さ方向に収納し、且つ前記管状光源からの前記光源光を前記導光板に導くよう前記厚さ方向に形成される光導入平面を含む収納部を備えたことを特徴とした面光源装置。

【請求項2】　請求項1記載の突起は、前記導光板内を伝播する前記管状光源からの前記光源光を前記導光板外に出射する出射面と、前記導光板内を伝播する前記管状光源からの前記光源光を前記出射面に導くまたは前記導光板内に反射する反射面とを含む断面三角形状であることを特徴とした面光源装置。

【請求項3】　複数の表示画素から成る有効表示領域を含む表示パネルと、前記表示パネルに面光源光を照射する管状光源及び前記管状光源からの光源光を選択的に出射する複数の突起を一主表面に含む導光板とを備えた面光源装置とを含む表示装置において、
前記導光板は、前記管状光源を前記導光板の厚さ方向に収納し、且つ前記管状光源からの前記光源光を前記導光板に導くよう前記厚さ方向に形成される光導入平面を含む収納部を備えたことを特徴とした表示装置。

【請求項4】　請求項3記載の管状光源は、前記表示パネルの前記有効表示領域内に対応して配置されることを特徴とする表示装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、面光源装置およびそれを用いた表示装置に関する。

【0002】

【従来の技術】液晶表示装置に代表される表示装置は、薄型、軽量、低消費電力といった特徴を生かして、テレビ、コンピュータあるいはカーナビゲーション用等の各種表示装置として利用されるようになってきた。

【0003】例えば、光透過型の液晶表示装置は、一対の電極基板間に液晶層が保持されて成る液晶パネルと、この液晶パネルの一主面上に配置され、この液晶パネルに光源光を導く面光源装置とを含む。

【0004】このような表示装置において、よりいっそうの装置の薄型、小型化には、面光源装置の薄型化を達成する必要があり、バックライト方式からエッジライト方式の面光源装置が用いられるようになってきた。

【0005】エッジライト方式の面光源装置は、実開昭63－24529号公報等に開示されるように、管状光源と、裏面側に乳白色の散乱パターンが印刷されたアクリル樹脂などの薄板形状の導光板とを含み、この管状光源に導光板の一端面が近接配置されて成っている。そして、管状光源からの光源光は、導光板中を伝搬し、導光板裏面の散乱パターンによって散乱され、導光板主表面に出射される。

【0006】上記したエッジライト方式の面光源装置によれば、装置の薄型化を達成できるものの、散乱パターンによる光損失の他、導光板からの出射光は導光板の主表面に対して略180°の出射角（Ω）を有しているため、表示に寄与しない光源光も多く、このため光利用効率が悪い。従って、十分な表示輝度を確保するためには、面光源装置の消費電力を大きくせざるを得ない。

【0007】

【発明が解決しようとする課題】上記した問題点を解決するものとして、例えば特開平5－313163号公報や特開平6－75123号公報等に開示されるエッジライト方式の面光源装置が知られている。

【0008】これは、導光板の表示パネルと対向する主表面側に複数の突起部を配列し、この突起によって導光板からの出射光を制御するというもので、従来の散乱パターンを不要にでき、光利用効率を向上することができる。

【0009】以上のような技術背景の中、近年の表示装置では、より一層の小型化が要求され、特に表示領域に対する装置の外形寸法を小さくすること、即ち狭額縁化の要求が高まっている。

【0010】しかしながら、上記したエッジライト方式の面光源装置にあっては、導光板の光入射面に対向して管状光源を配置する都合上、管状光源は表示領域外に配置せざるを得ない。このため、管状光源の配置領域に額縁サイズは制約を受けてしまう。

【0011】この発明は、上記した技術課題に対処して成されたものであって、光利用効率が高く、しかも装置の狭額縁化が達成できる面光源装置およびそれを用いた表示装置を提供することを目的としている。

【0012】

【課題を解決するための手段】請求項1に記載される発明は、管状光源と、管状光源からの光源光を選択的に出射する複数の突起を一主表面に含む導光板とを備えた面光源装置において、前記導光板は、前記管状光源を前記導光板の厚さ方向に収納し、且つ前記管状光源からの前記光源光を前記導光板に導くよう前記厚さ方向に形成される光導入平面を含む収納部を備えたことを特徴としている。

【0013】請求項2に記載される発明は、請求項1記載の突起は、前記導光板内を伝播する前記管状光源からの前記光源光を前記導光板外に出射する出射面と、前記導光板内を伝播する前記管状光源からの前記光源光を前記出射面に導くまたは前記導光板内に反射する反射面とを含む断面三角形状であることを特徴としている。

【0014】請求項3に記載される発明は、複数の表示画素から成る表示領域を含む表示パネルと、前記表示パネルに面光源光を照射する管状光源及び前記管状光源からの光源光を選択的に出射する複数の突起を一主表面に

含む導光板とを備えた面光源装置とを含む表示装置において、前記導光板は、前記管状光源を前記導光板の厚さ方向に収納し、且つ前記管状光源からの前記光源光を前記導光板に導くよう前記厚さ方向に形成される光導入平面を含む収納部を備えたことを特徴としている。請求項４に記載される発明は、請求項３記載の管状光源は、前記表示パネルの前記表示領域内に対応して配置されることを特徴としている。

【００１５】

【作用】この発明によれば、管状光源は導光板の厚さ方向に収納されるので、面光源装置の外形寸法が管状光源に制約を受けることがない。よって、小型の面光源装置、更には額縁サイズの小さい表示装置の提供が可能となる。

【００１６】しかも、この発明によれば、導光板の光導入平面から入射される光源光を、導光板の主表面に配置される突起によって制御するため、従来のような散乱パターンによる光損失も軽減され、よって光利用効率を高めることができる。

【００１７】また、この突起を、導光板内を伝播する管状光源からの光源光を導光板内に反射する反射面と、導光板内を伝播する管状光源からの光源光を導光板外に出射する出射面とを含む断面三角形状とすることにより、導光板からの出射光の広がりを十分に抑え、よって光利用効率をより一層向上させることができる。

【００１８】

【実施例】以下に、本発明の一実施例の液晶表示装置(1) について図面を参照して説明する。この実施例の液晶表示装置(1) は、図１乃至２に示すように、ノーマリ・ホワイト・モードで動作する光透過型の液晶パネル(101)、液晶パネル(101) の一端辺に配置される４個のＸ－ＴＡＢ(801),(802),(803),(804)、対向する一端辺に配置される４個のＸ－ＴＡＢ(806)、液晶パネル(101) の他の一端辺に配置される２個のＹ－ＴＡＢ(821),(822)、４個のＸ－ＴＡＢ(801),…,(804)に接続されるＸ駆動回路基板(811)、他の４個のＸ－ＴＡＢ(806) に接続されるＸ駆動回路基板(813)、２個のＹ－ＴＡＢ(821),(823) に接続されるＹ駆動回路基板(831)、液晶パネル(101) の裏面側に配置される面光源装置(901) とを含む。

【００１９】Ｘ－ＴＡＢ(801),…,(804),(806)のそれぞれは、液晶表示装置(1) の外形寸法を小さくするよう、面光源装置(901) の裏面側に折り曲げられ、面光源装置(901) の裏面側に配置されるＸ駆動回路基板(811),(806) に接続されている。

【００２０】液晶パネル(101) は、対角１４インチの表示領域(103) を備えており、図４に示すように、アレイ基板(200) と対向基板(300) とがシール材（図示せず）を介して５ミクロンの間隙を保持して配置され、この間隙に、互いに直交する方向にラビング処理が施されて配向性が付与されて成る配向膜(291),(391) を介して正の誘電率異方性を有するネマチック液晶材料を主体とした液晶層(401) が保持されて成る。

【００２１】アレイ基板(200) は、図３乃至４に示すように、ガラス基板(201) の一主表面側に複数本の走査線Ｙｊ (j=1,2,…,n) と複数本の信号線Ｘｉ (i=1,2,…,m) とがマトリクス状に配置され、走査線Ｙｊと信号線Ｘｉとによって囲まれる領域にＩＴＯ (Indium-Tin-Oxide) から成る透明な画素電極(251) が配置されている。走査線Ｙｊと信号線Ｘｉとの各交点近傍には、薄膜トランジスタ（以下、ＴＦＴと略称する。）(231) が配置されている。このＴＦＴ(231) は、走査線Ｙｊ自体をゲート電極(211) とし、ゲート電極(211) 上に配置される絶縁膜(213)、絶縁膜を介して配置される島状の非晶質シリコン（ａ－Ｓｉ：H）薄膜(215)、ａ－Ｓｉ：H薄膜(215) 上に配置されるチャネル保護膜(217)、ａ－Ｓｉ：H薄膜(215) に信号線Ｘｉから延在されて電気的に接続されるドレイン電極(221)、画素電極(251) とａ－Ｓｉ：H薄膜(215) とを電気的に接続するソース電極(223) とを備えている。また、ドレイン電極(221) 及びソース電極(223) とａ－Ｓｉ：H薄膜(217) との間には、良好なオーミック接合が得られるよう低抵抗半導体膜として不純物としてリンを含有するn^+ 型ａ－Ｓｉ：H薄膜(222),(224) がそれぞれ配置されている。

【００２２】また、走査線Ｙｊと同一材料からなり、走査線Ｙｊと略平行に配線される補助容量線Ｃｊがガラス基板(201) 上に配置され、画素電極(251) と補助容量線Ｃｊとによって補助容量 (Cs) が形成されている。

【００２３】対向基板(300) は、アレイ基板(200) と対向するガラス基板(301) 上に、アレイ基板(200) のＴＦＴ(231)，信号線Ｘｉと画素電極(251) との隙間および走査線Ｙｊと画素電極(251) との隙間を遮光するよう配置される遮光膜(311)、遮光膜(311) 間に配置される赤（Ｒ），緑（Ｇ），青（Ｂ）の色部から成るカラーフィルタ層(321)、カラーフィルタ層(321) 上に配置されるＩＴＯから成る対向電極(331) とを含む。

【００２４】そして、アレイ基板(200) 及び対向基板(300) の外表面には、それぞれ偏光板(411),(421) が貼付され、このようにして複数の表示画素を備えた液晶パネル(101) は構成される。

【００２５】次に、面光源装置(901) について説明する。この面光源装置(901) は、図２に示すように、アクリル樹脂から成り、液晶パネル(101) の有効表示領域(103) よりも若干大きい略長方形状の導光板(911)、導光板(911) のランプ収納溝(921)内に配置される管状光源(951)、ランプ収納溝(921) を覆う反射フィルム(961)、導光板(911) と液晶パネル(101) との間に配置されるプリズムシート(991) とを含む。

【００２６】導光板(911) は、液晶パネル(101) の有効表示領域(103) に対応する領域内、更に詳しくは裏面中

央部分に導光板(911)の長辺と略平行に形成されたランプ収納溝(921)を備え、このランプ収納溝(921)に管状光源(951)は格納される。そして、ランプ収納溝(921)から導光板(911)端に向かって板厚が薄くなるようテーパー状に整形されている。

【００２７】そして、導光板(911)は、図５（ａ）に示すように、ランプ収納溝(921)に対応する領域を第３領域、この第３領域を挟む第１及び第２領域とに機能的に区分される。

【００２８】このランプ収納溝(921)は、導光板(911)の第１領域に管状光源(951)からの光源光を導くよう導光板(911)の厚さ方向に形成される第１光導入平面(921a)、導光板(911)の第２領域に光源光を導くよう導光板(911)の厚さ方向に形成される第２光導入平面(921b)、導光板(911)の第３領域に光源光を導くよう導光板(911)の主表面に略平行に形成される第３光導入平面(921c)とを含む。

【００２９】導光板(911)の主表面上の第１領域には、第１光導入平面(921a)から導入される光源光を選択的に、且つ導光板(911)から出射される光源光の広がりを抑えるよう、断面三角形状の第１突起列(913)が第１光導入平面(921a)と略平行に複数列配列されている。また、導光板(911)の主表面上の第２領域にも、第２光導入平面(921b)から導入される光源光を選択的に、且つ導光板から出射される光源光の広がりを抑えるよう、断面三角形状の第２突起列(915)が第２光導入平面(921b)と略平行に複数列配列される。これら第１、第２突起列(913),(915)は、管状光源(951)から遠ざかるにつれてその間隙が密になっており、これによって表示輝度の均一性を確保している。

【００３０】第１突起列(913)のそれぞれは、図４に示すように、第１光導入平面(921a)側に反射面(913a)、導光板(911)の端辺側に出射面(913b)を含む。また、第２突起列(915)のそれぞれも、第２光導入平面(921b)側に反射面(915a)、導光板(911)の端辺側に出射面(915b)を含む。即ち、導光板(911)は、第３領域を介して第１領域と第２領域とは対称である。

【００３１】管状光源(951)から第１光導入平面側(921a)及び第２光導入平面側(921b)を介して入射される光源光のそれぞれは、導光板(911)がアクリル樹脂製であることから、第１光導入平面(921a)の垂線に対して略４２°の集光角（Ω１）を、また第２光導入平面(921b)の垂線に対して略４２°の集光角（Ω１）をもってそれぞれ入射される。

【００３２】このようなことから、第１光導入平面(921a)及び第２光導入平面(921b)の垂線に対して各突起列(913),(915)の反射面(913a),(915a)との成す角度（θ１）は４０°に設定され、また各突起列(913),(915)の出射面(913b),(915b)との成す角度（θ２）は略９０°に設定されている。ここでは、角度（θ１）を４０°に設定したが、角度（θ１）はこれに限定されるものではなく、第１，第２光導入平面(921a),(921b)から入射される光源光を概ね各突起列(913),(915)の出射面(913b),(915b)に導くよう設定されるものであれば良い。しかしながら、角度（θ１）が小さすぎると、各突起列(913),(915)を多数配列させることができなくなり、輝度むらを招く恐れがあることから、２０～４０°の範囲内に設定することが望ましい。特にこの実施例では、導光板(911)の板厚が管状光源(951)から導光板(911)端に向かって薄くなるようにテーパー状に整形されているため、各突起列(913),(915)の反射面(913a),(915a)との成す角度（θ１）を、例えば４２°を越えて大きく設定することができ、これにより多数の突起列(913),(915)を配列させることが可能となり、これにより輝度むらをより一層抑えることが可能となる。

【００３３】また、ここでは角度（θ２）を略９０°に設定したが、出射光の広がりを小さくする上で８０°以上であることが望ましく、９０°を越える鈍角であっても良い。

【００３４】このような構成により、第１突起列(913)の出射面(913b)からは導光板(911)の一端辺に向かって略９０°の広がり角（Ω２）に集光された光源光が出射され、また第２突起列(915)の出射面(915b)からは導光板(911)の他端辺に向かってやはり略９０°の広がり角（Ω２）に集光された光源光が出射される。

【００３５】液晶パネル(101)と導光板(911)との間に配置されるプリズムシート(991)は、導光板(911)側に向かって突出し、導光板(911)の突起列(913),(915)と略平行に配列された複数の突起列(993),(995)を含む。これら突起列(993),(995)は、導光板(991)からの出射光を液晶パネル(101)側に導く屈折面(993a),(995a)を含み、プリズムシート(991)の主表面と屈折面(993a),(995a)との成す角度（θ３）は略３５°に設定されている。

【００３６】これにより、導光板(911)端辺に向かって出射される光源光は、液晶パネル(101)側に向かう集光角（Ω３）２２°の光源光に制御される。また、導光板(911)の第３光入射平面(921c)から入射される光源光は、導光板(911)から光拡散シート(981)を介して出射される。導光板(911)の第３領域に光拡散シート(981)を配したのは、第３領域が第１及び第２領域に比べて光源輝度が極端に大きくなることを防止するためであって、光拡散シート(981)は第３光導入平面(921c)と管状光源(951)との間に配置しても良く、また第３領域の導光板(911)主表面あるいは第３光導入平面(921c)を梨地状に荒らす等してもかまわない。

【００３７】以上の構成により、この液晶表示装置(1)は、次のように動作する。管状光源(951)から導光板(911)の第３光導入平面(921c)に入射される光源光は、第３光導入平面(921c)から導光板(911)内に入射され、光

拡散シート(981)を介し、更にプリズムシート(991) を介して液晶パネル(101) に入射される。

【００３８】導光板(911) の第１光導入平面(921a)に入射される光源光は、導光板(911) 内を伝播し、その一部が第１突起列(913) の出射面(913b)から出射される。同様に、導光板(911) の第２光導入平面(921b)に入射される光源光も、導光板(911) 内を伝播し、その一部が第２突起列(915) の出射面(915b)から出射される。

【００３９】このようにして導光板(911) から出射される出射光は、略９０°の拡散光に制御される。そして、導光板(911) から出射される出射光は、プリズムシート(991) によって液晶パネル(101) に向かう集光角（Ω3）２２°の光源光に制御される。

【００４０】以上説明したように、この実施例の液晶表示装置(1) によれば、管状光源(951) が、有効表示領域(103) に対応する導光板(911) の厚さ方向に収納されるので、液晶表示装置(1) の外形寸法が管状光源(951) に制約を受けることがなく、よって装置の小型化を達成することができる。しかも、導光板(911) はテーパー状であって、その板厚の薄い領域にＸ駆動回路基板(811),(806) が配置されているので、液晶表示装置(1) の一層の狭額縁化を達成することができた。

【００４１】また、管状光源(951) は、液晶表示装置(1) の裏面もしくは側面から容易に着脱できるので、メンテナンスが容易である。例えば、管状光源(951) と反射フィルム(961) とをユニット化して導光板(911) に着脱可能にすれば、光源の交換がより容易となる。

【００４２】また、この面光源装置(901) からの光源光は、その集光角が小さく制御されているので、光利用効率が高く、よって装置の低消費電力化を達成することができる。

【００４３】例えば、導光板裏面に散乱パターンが配された従来の面光源装置に比べて、この実施例によれば、液晶表示装置における表示輝度を十分に向上させることができた。

【００４４】上述した実施例では、管状光源(951) を導光板(911) の中央部分に配置した場合を例にとり説明したが、この発明はこれに限定されるものではなく、例えば図５（ｂ）に示すように、導光板(911) の端辺近傍に配置されるものであっても良い。

【００４５】また、上述した実施例では、導光板(911) の中央部分にランプ収納溝(921) を配置した場合を例にとり説明したが、これは導光板(911) を貫通するものであってもかまわない。

【００４６】

【発明の効果】この発明の面光源装置によれば、光利用効率が高く、しかもこの面光源装置を用いた表示装置によれば装置の狭額縁化を達成することができる。

【図面の簡単な説明】

【図１】図１は、本発明の一実施例の液晶表示装置の概略斜視図である。

【図２】図２は、図１中Ａ－Ａ’線に沿って切断した表示装置の概略断面図である。

【図３】図３は、本発明の一実施例の液晶表示装置のアレイ基板の一部概略正面図である。

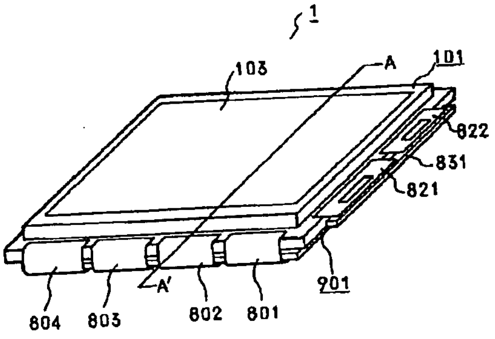
【図４】図４は、本発明の一実施例の液晶表示装置の一部概略断面斜視図である。

【図５】図４は、本発明の一実施例における面光源装置の機能を説明するための図である。

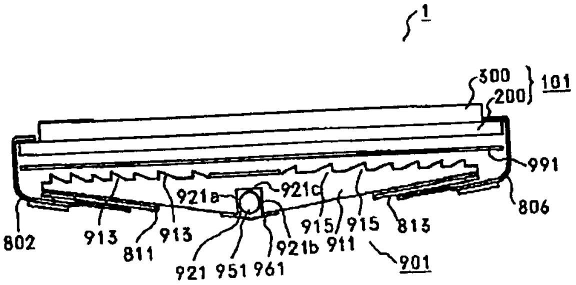
【符号の説明】

(1) …液晶表示装置
(100) …アレイ基板
(300) …対向基板
(901) …面光源装置
(913), (915) …突起列
(913a), (915a) …反射面
(913b), (915b) …出射面
(951) …管状光源

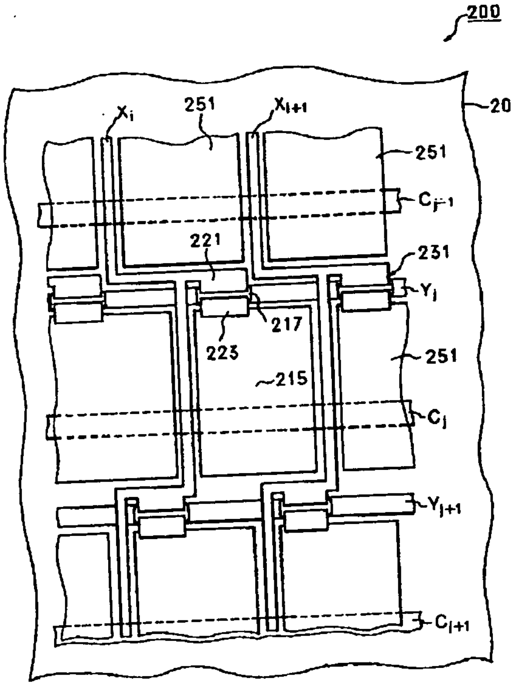
【図１】



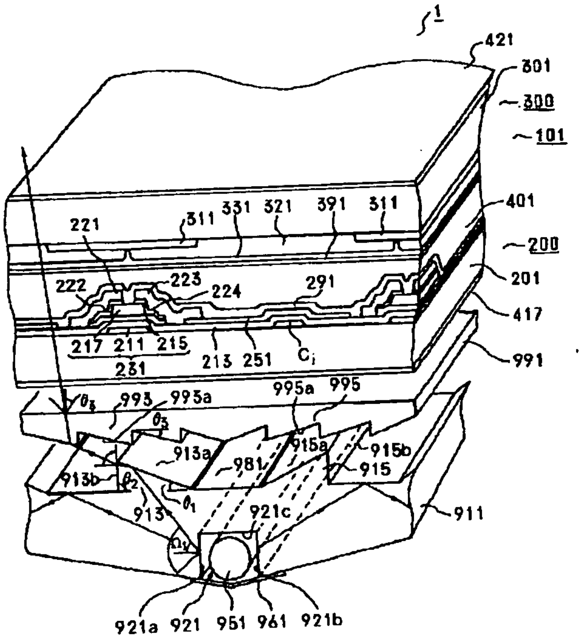
【図２】



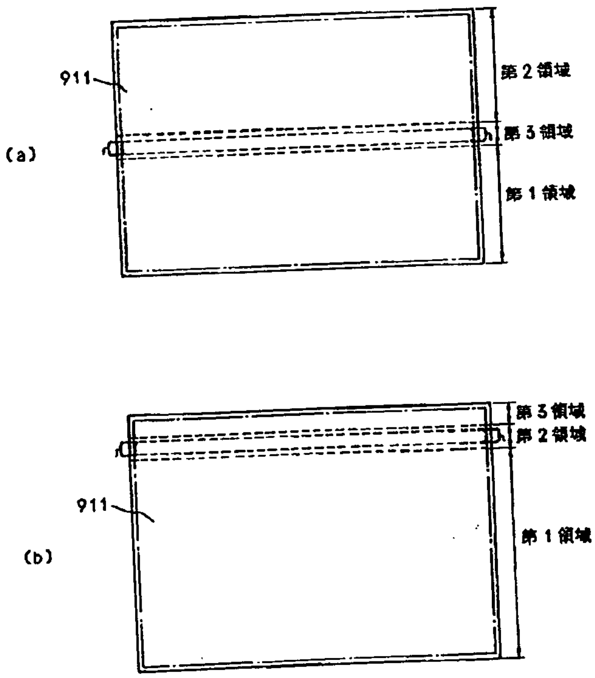
【図3】


200
201
X_i
251
X_{i+1}
251
C_{j-1}
221
231
Y_j
217
223
251
215
C_j
Y_{j+1}
C_{j+1}

【図4】


C_j
θ_3
θ_3
θ_2
θ_1
α_1

【図5】


911
第2領域
第3領域
(a)
第1領域
第3領域
第2領域
911
(b)
第1領域

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-271886
(43)Date of publication of application : 18.10.1996

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(51)Int.Cl. G02F 1/1335
F21V 8/00
G02B 6/00

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(21)Application number : 07-070288
(22)Date of filing : 29.03.1995
(71)Applicant : TOSHIBA CORP
(72)Inventor : HIGUCHI YOSHINORI

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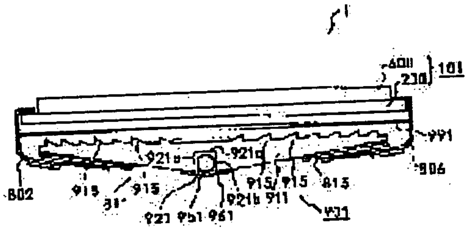
(54) SURFACE LIGHT SOURCE DEVICE AND DISPLAY DEVICE USING THE SAME

(57)Abstract:

PURPOSE: To provide a compact surface light source device whose outside dimension is not restricted by a tubular light source by housing the tubular light source in the thickness direction of a light transmission plate.

CONSTITUTION: This light source device is provided with a lamp housing groove 921 formed nearly in parallel with the long side of the light transmission plate 911 in the center part of its back surface, and the tubular light source 951 is housed in the groove 921. The device is shaped to be tapered so that plate thickness may be reduced toward the end of the plate 911 from the groove 921. Then, light source light made incident on the 1st light introducing plane 921a of the plate 911 is propagated in the plate 911 and a part of the light is emitted from the emitting surface of a 1st projection train 913. In the same manner, the light source light made incident on the 2nd light introducing plane 921b of the plate 911 is also propagated in the plate 911 and a part of the light is emitted from the emitting surface of a 2nd projection train 915. The emitted light emitted from the plate 911 is controlled to be diffused light whose angle 13 about 90° , and controlled to be the light source light whose condensing angle is 22° and which faces to a liquid crystal panel 101 by a prism sheet 991.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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[JP,08-271886,A]

CLAIMS

[Claim(s)]
[Claim 1] It is surface light source equipment which carried out [that the aforementioned light guide plate was equipped with the stowage containing the optical introduction flat surface formed in the aforementioned thickness direction so that the aforementioned tubular light source may be contained in the thickness direction of the aforementioned light guide plate and the aforementioned light source light from the aforementioned tubular light source may lead to the aforementioned light guide plate in surface light source equipment equipped with the tubular light source and the light guide plate which includes two or more salients which carry out outgoing radiation of the light source light from the tubular light source alternatively on a 1 main front face, and] as the feature.

[Claim 2] A salient according to claim 1 is surface light source equipment characterized by having the shape of a cross-section triangle containing the outgoing radiation side which carries out outgoing radiation of the aforementioned light source light from the aforementioned tubular light source which spreads the inside of the aforementioned light guide plate out of the aforementioned light guide plate, and the reflector reflected in the aforementioned light guide plate or it leads the aforementioned light source light from the aforementioned tubular light source which spreads the inside of the aforementioned light guide plate to the aforementioned outgoing radiation side.

[Claim 3] It is the display characterized by having a stowage containing the optical introduction flat surface formed in the aforementioned thickness direction so that the aforementioned light guide plate may contain the aforementioned tubular light source in the thickness direction of the aforementioned light guide plate in the display containing the surface light source equipment characterized by providing the following and the aforementioned light source light from the aforementioned tubular light source may be led to the aforementioned light guide plate. The display panel containing the effective viewing area which consists of two or more display pixels. The light guide plate which includes two or more salients which carry out outgoing radiation of the light source light from the tubular light source which irradiates surface light source light, and the aforementioned tubular light source to the aforementioned display panel alternatively on a 1 main front face.

[Claim 4] The tubular light source according to claim 3 is display characterized by being arranged corresponding to the inside of the aforementioned effective viewing area of the aforementioned display panel.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the display which used surface light source equipment and it.

[0002]
[Description of the Prior Art] The display represented by the liquid crystal display has come to be used as various display television, a computer, for car navigation, etc. taking advantage of the features, such as a thin shape, lightweight, and a low power.

[0003] For example, a light-transmission type liquid crystal display is arranged on the 1 principal plane of the liquid crystal panel which a liquid crystal layer is held and changes between the electrode substrates of a couple, and this liquid crystal panel, and contains the surface light source equipment which leads light source light to this liquid crystal panel.

[0004] It is necessary to attain thin shape-ization of surface light source equipment for the thin shape of much more equipment, and a miniaturization, and the surface light source equipment of a back light method to an edge light method has come to be used for them in such display.

[0005] Including the tubular light source and the light guide plate of forms of sheet, such as acrylic resin by which the dispersion pattern of opalescence was printed at the rear-face side, contiguity arrangement of the end side of a light guide plate is carried out, and the surface light source equipment of an edge light method became this tubular light source so that it might be indicated by JP,63-24529,U etc. And the light source light from the tubular light source spreads the inside of a light guide plate, and is scattered about with the dispersion pattern on the rear face of a light guide plate, and outgoing radiation is carried out to a light guide plate main front face.

[0006] Although thin shape-ization of equipment can be attained, since the outgoing radiation light from a light guide plate besides the optical loss by the dispersion pattern has the outgoing radiation angle (omega) of 180 degrees of abbreviation to the main front face of a light guide plate, it also has much light source light which does not contribute to a display, and its efficiency for light utilization is bad [for this reason] according to the surface light source equipment of the above-mentioned edge light method. Therefore, in order to secure sufficient display brightness, power consumption of surface light source equipment must be enlarged.

[0007]
[Problem(s) to be Solved by the Invention] As what solves the above-mentioned trouble, the surface light source equipment of the edge light method indicated by JP,5-313163,A, JP,6-75123,A, etc. is known.

[0008] This can be said to arrange two or more heights and to control the outgoing radiation light from a light guide plate by this salient, can make the conventional dispersion pattern unnecessary at the display-panel [of a light guide plate], and main front-face side which counters, and can improve efficiency for light utilization.

[0009] in the above technical backgrounds, with display in recent years, the miniaturization of a monostromatic is required more and the demand of making small the dimension of the equipment especially to a viewing area, i.e., narrow-picture-frame-izing, is increasing

[0010] However, if it is in the surface light source equipment of the above-mentioned edge light method, the tubular light source must be arranged out of a viewing area for the sake of the convenience which counters the optical plane of incidence of a light guide plate, and arranges the tubular light source. For this reason, frame size will receive restrictions in the arrangement field of the tubular light source.

[0011] this invention copes with the above-mentioned electric power technology division title, is accomplished, and its efficiency for light utilization is high, and it aims at offering the surface light source equipment which can moreover attain narrow picture frame-ization of equipment, and the display using it

[0012]
[Means for Solving the Problem] In the surface light source equipment with which invention indicated by the claim 1 was equipped with the tubular light source and the light guide plate which includes two or more salients which carry out outgoing radiation of the light source light from the tubular light source alternatively on a 1 main front face the aforementioned light guide plate It is

characterized by having a stowage containing the optical introduction flat surface formed in the aforementioned thickness direction so that the aforementioned tubular light source may be contained in the thickness direction of the aforementioned light guide plate and the aforementioned light source light from the aforementioned tubular light source may be led to the aforementioned light guide plate.

[0013] It is carrying out that invention indicated by the claim 2 has the shape of a cross-section triangle containing the outgoing-radiation side which carries out outgoing radiation of the aforementioned light source light from the aforementioned tubular light source with which a salient according to claim 1 spreads the inside of the aforementioned light guide plate out of the aforementioned light guide plate, and the reflector reflected in the aforementioned light guide plate or it leads the aforementioned light source light from the aforementioned tubular light source which spreads the inside of the aforementioned light guide plate to the aforementioned outgoing-radiation side as the feature.

[0014] The display panel containing the viewing area to which invention indicated by the claim 3 changes from two or more display pixels, In the display containing surface light source equipment equipped with the light guide plate which includes two or more salients which carry out outgoing radiation of the light source light from the tubular light source which irradiates surface light source light, and the aforementioned tubular light source to the aforementioned display panel alternatively on a 1 main front face The aforementioned light guide plate is characterized by having a stowage containing the optical introduction flat surface formed in the aforementioned thickness direction so that the aforementioned tubular light source may be contained in the thickness direction of the aforementioned light guide plate and the aforementioned light source light from the aforementioned tubular light source may be led to the aforementioned light guide plate. Invention indicated by the claim 4 is characterized by arranging the tubular light source according to claim 3 corresponding to the inside of the aforementioned viewing area of the aforementioned display panel.

[0015]
[Function] According to this invention, since the tubular light source is contained in the thickness direction of a light guide plate, the dimension of surface light source equipment does not receive restrictions in the tubular light source. Therefore, offer of small surface light source equipment and display with still smaller frame size is attained.

[0016] And since the light source light by which incidence is carried out from the optical introduction flat surface of a light guide plate is controlled by the salient arranged on the main front face of a light guide plate according to this invention, the optical loss by dispersion pattern like before is also mitigated, and, therefore, efficiency for light utilization can be raised.

[0017] Moreover, by considering as the shape of a cross-section triangle including the reflector which reflects the light source light from the tubular light source which spreads the inside of a light guide plate for this salient in a light guide plate, and the outgoing radiation side which carries out outgoing radiation of the light source light from the tubular light source which spreads the inside of a light guide plate out of a light guide plate, the breadth of the outgoing radiation light from a light guide plate can fully be stopped, and, therefore, efficiency for light utilization can be raised further.

[0018]
[Example] the following -- liquid crystal display (1) of one example of this invention ******** -- it explains with reference to a drawing Liquid crystal display of this example (1) The light-transmission type liquid crystal panel (101) which operates by the normally white mode as shown in drawing 1 or 2, Liquid crystal panel (101) Four X-TAB arranged the end side (801), Four X-TAB (806) arranged (802), (803) (804), and the end side that counters, Liquid crystal panel (101) Two Y-TAB arranged other end sides (821), , four X-TAB (801), --, X drive circuit board (811) connected to (804), (822) Other four X-TAB (806) (823) X drive circuit board (813) connected and two Y-TAB

(821), Y drive circuit board (831) and the liquid crystal panel (101) which are connected Surface light source equipment arranged at a rear-face side (901) It contains.

[0019] Each of X-TAB (801), --, (804), and (806) is a liquid crystal display (1). It is surface light source equipment (901) so that a dimension may be made small. It is bent at a rear-face side and is surface light source equipment (901). X drive circuit board arranged at a rear-face side (811) (806), It connects.

[0020] Liquid crystal panel (101) Viewing area of 14 inches of vertical angles (103) As it has and is shown in drawing 4 Array substrate (200) Opposite substrate (300) Through a sealant (not shown), hold a 5-micron gap and it is arranged. Orientation film which rubbing processing is performed in the direction which intersects perpendicularly with this gap mutually, and a stacking tendency is given, and changes (291) (391), Liquid crystal layer which made the subject nematic-liquid-crystal material which minds and has a positive dielectric constant anisotropy (401) It is held and changes.

[0021] Array substrate (200) As shown in drawing 3 or 4, it is a glass substrate (201). Two or more scanning lines Yj (j= 1, 2, --, n) and two or more signal lines Xi (i= 1, 2, --, m) are arranged in the shape of a matrix at a 1 main front-face side. Transparent pixel electrode which changes from ITO (Indium-Tin-Oxide) to the field surrounded by the scanning line Yj and the signal line Xi (251) It is arranged. Near [intersection] each [of the scanning line Yj and a signal line Xi], it is TFT (it is hereafter called TFT for short.) (231). It is arranged. This TFT (231) It is a gate electrode (211) in the scanning-line Yj itself. It carries out. Gate electrode (211) The amorphous silicon (a-Si:H) thin film (215) of the shape of an island arranged through the insulator layer (213) arranged upwards and an insulator layer, a-Si:H thin film (215) The channel protective coat (217) arranged upwards, a-Si:H thin film (215) The drain electrode (221) which extends from a signal line Xi and is connected electrically, and pixel electrode (251) a-Si:H thin film (215) Source electrode which connects electrically (223) It has. Moreover, drain electrode (221) (224) And source electrode (223) a-Si:H thin film (217) n+ which contains Lynn as an impurity as a low resistance semiconductor film so that good ohmic junction may be obtained in between Type a-Si:H thin film (222), It is arranged, respectively.

[0022] Moreover, the auxiliary capacity line Cj which it becomes from the same material as the scanning line Yj, and is wired by the scanning line Yj and abbreviation parallel is a glass substrate (201). It is arranged upwards and is a pixel electrode (251). Auxiliary capacity (Cs) is formed by the auxiliary capacity line Cj.

[0023] Opposite substrate (300) Array substrate (200) Glass substrate which counters (301) Upwards Array substrate (200) TFT (231), and a signal line Xi and a pixel electrode (251) A crevice, and the scanning line Yj and a pixel electrode (251) The shading film (311) arranged so that a crevice may be shaded, Shading film (311) The red (R) stationed in between, green (G), the light-filter layer (321) which consists of a blue (B) color part, and light-filter layer (321) Counterelectrode which consists of ITO arranged upwards (331) It contains.

[0024] And array substrate (200) (421) And opposite substrate (300) In an outside surface, it is a polarizing plate (411), respectively. Liquid crystal panel which was stuck, did in this way and was equipped with two or more display pixels (101) It is constituted.

[0025] next, surface light source equipment (901) ******** -- it explains This surface light source equipment (901) As shown in drawing 2 , it consists of acrylic resin. Liquid crystal panel (101) Effective viewing area (103) The light guide plate (911) of the shape of a large abbreviation rectangle a little, Light guide plate (911) The tubular light source (951) arranged in a lamp receipt slot (921), and lamp receipt slot (921) A wrap reflective film (961) and light guide plate (911) Liquid crystal panel (101) Prism sheet arranged in between (991) It contains.

[0026] Light guide plate (911) Liquid crystal panel (101) Effective viewing area (103) It is a light guide plate (911) to a part for a rear-face center section in more detail in a corresponding field. A long side and lamp receipt slot formed in abbreviation parallel (921) It has and is this lamp receipt slot (921). Tubular light source (951) It is stored. And lamp receipt slot (921) Shell light guide plate (911) It is orthopedically operated in the shape of a taper so that board thickness may become thin toward an edge.

[0027] And light guide plate (911) As shown in drawing 5 (a), it is a lamp receipt slot (921). A corresponding field is functionally classified into the 3rd field, the 1st which face across this 3rd field, and 2nd fields.

[0028] This lamp receipt slot (921) Light guide plate (911) It is the tubular light source (951) to the 1st field. It is a light guide plate (911) so that the light source light of a shell may be drawn. The 1st light introduction flat surface formed in the thickness direction (921a), Light guide plate (911) It is a light guide plate (911) so that light source light may be led to the 2nd field. The 2nd light introduction flat surface formed in the thickness direction (921b), Light guide plate (911) It is a light guide plate (911) so that light source light may be led to the 3rd field. The 3rd light introduction flat surface (921c) formed in the main front face at abbreviation parallel is included.

[0029] light guide plate (911) the light source light introduced into the 1st field on the main front face from the 1st light introduction flat surface (921a) -- alternative -- and light guide plate (911) from -- the breadth of the light source light by which outgoing radiation is carried out is stopped -- as -- the cross-section triangle-like 1st salient train (913) Two or more trains array is carried out with the 1st light introduction flat surface (921a) at abbreviation parallel. Moreover, light guide plate (911) It is the cross-section triangle-like 2nd salient train (915) so that the breadth of the light source light by which outgoing radiation is alternatively carried out from a light guide plate in the light source light introduced also into the 2nd field on the main front face from the 2nd light introduction flat surface (921b) may be stopped. Two or more trains array is carried out with the 2nd light introduction flat surface (921b) at abbreviation parallel. these [1st] and the 2nd salient train (913) (915) The tubular light source (951) from -- the gap is dense as it keeps away, and the homogeneity of display brightness is secured by this

[0030] The 1st salient train (913) Each is a reflector (913a) and a light guide plate (911) to the 1st light introduction flat-surface (921a) side, as shown in drawing 4 . An outgoing radiation side (913b) is included in a **** side. Moreover, the 2nd salient train (915) Each also includes an outgoing radiation side (915b) in the 2nd light introduction flat-surface (921b) side at the **** side of a reflector (915a) and a light guide plate (911). Namely, light guide plate (911) The 1st field and the 2nd field are symmetrical through the 3rd field.

[0031] Tubular light source (951) Each of the light source light by which reaches the 1st light introduction flat-surface side (921a) of a shell, and incidence is carried out through the 2nd light introduction flat-surface side (921b) light guide plate (911) the perpendicular of the 1st light introduction flat surface (921a) since it is a product made of acrylic resin -- receiving -- the converging angle (omega 1) of 42 degrees of abbreviation -- the [moreover,] -- incidence is carried out with the converging angle (omega 1) of 42 degrees of abbreviation to the perpendicular of 2 light introduction flat surface (921b), respectively

[0032] From such a thing, it reaches the 1st light introduction flat surface (921a), and the perpendicular of the 2nd light introduction flat surface (921b) is received. Each salient train (913), (915) (915a) (915) Reflector (913a) (915b), It is set as 40 degrees and the angle (theta 1) to accomplish is each salient train (913). Outgoing radiation side (913b), The angle (theta 2) to accomplish is set as 90 degrees of abbreviation. that by which an angle (theta 1) is limited to this here although the angle (theta 1) was set as 40 degrees -- it is not -- the 1st and the 2nd light introduction flat surface (921a) (915) (921b) (915b) from -- the light source light by which incidence is carried out -- in general -- each salient train (913) Outgoing radiation side (913b), What is necessary is to just be set up so that it may lead. However, if an angle (theta 1) is too small, it is each salient train (913) (915). Since there is a possibility of it becoming impossible to make a large number arranging, and causing brightness unevenness, it is desirable to set up within the limits of 20-40 degrees. At this example, it is especially a light guide plate (911). Board thickness is the tubular light source (951). Shell light guide plate (911) Since it is orthopedically operated in the shape of a taper so that it may become thin toward an edge, Each salient train (915a) (913) (915) Reflector (913a), The angle (theta 1) to accomplish For example, it can set up greatly exceeding 42 degrees, it becomes possible to make many salient trains (913) and (915) arrange by this, and it enables this to suppress brightness unevenness further.

[0033] Moreover, although the angle (theta 2) was set as 90 degrees of abbreviation here, it may be desirable that it is 80 degrees or more when making the breadth of outgoing radiation light small, and it may be an obtuse angle exceeding 90 degrees.

[0034] By such composition, it is the 1st salient train (913). From an outgoing radiation side (913b), outgoing radiation of the light source light condensed by the angle of divergence (omega 2) of 90 degrees of abbreviation toward the end side of a light guide plate (911) is carried out. It is the 2nd salient train (915) again. It is a light guide plate (911) from an outgoing radiation side (915b). Outgoing radiation of the light source light too condensed by the angle of divergence (omega 2) of 90 degrees of abbreviation toward the other end side is carried out.

[0035] Liquid crystal panel (915) (101) (995) Light guide plate (911) Prism sheet arranged in between (991) Light guide plate (911) It projects toward a side and is a light guide plate (911). Salient train (913), Two or more salient trains arranged by abbreviation parallel (993), It contains. These salient train (995a) (993) (995) Light guide plate (991) It is a liquid crystal panel (101) about the outgoing radiation light of a shell. The refracting interface (993a) and (995a) which are led to a side are included, and it is a prism sheet (991). The main front face and refracting interface (993a), The angle (theta 3) to accomplish is set as 35 degrees of abbreviation.

[0036] Thereby, it is a light guide plate (911). The light source light by which outgoing radiation is carried out toward **** is a liquid crystal panel (101). It is controlled by the light source light of 22 degrees of converging angles which go to a side (omega 3). Moreover, light guide plate (911) The light source light by which incidence is carried out from the 3rd light incidence flat surface (921c) is a light guide plate (911). Shell light diffusion sheet (981) Outgoing radiation is minded and carried out. Light guide plate (911) It is an optical diffusion sheet (981) to the 3rd field. Having allotted It is for light source brightness to be extremely large and for the 3rd field to prevent a bird clapper compared with the 1st and 2nd fields. optical diffusion sheet (981) The 3rd light introduction flat surface (921c) and the tubular light source (951) between -- you may arrange -- moreover, light guide plate (911) of the 3rd field the [a main front face or] -- it does not matter even if it carries out to damage 3 light introduction flat surface (921c) in the shape of crepe etc.

[0037] By the above composition, it is this liquid crystal display (1). It operates as follows. Tubular light source (951) Shell light guide plate (911) The light source light by which incidence is carried out to the 3rd light introduction flat surface (921c) is the 3rd light introduction flat surface (921c) to a light guide plate (911). Incidence is carried out inside, an optical diffusion sheet (981) is minded, and it is a prism sheet (991) further. It minds and is a liquid crystal panel (101). Incidence is carried out.

[0038] Light guide plate (911) The light source light by which incidence is carried out to the 1st light introduction flat surface (921a) is a light guide plate (911). Inside is spread and the part is the 1st salient train (913). Outgoing radiation is carried out from an outgoing radiation side (913b). Similarly, it is a light guide plate (911). The light source light by which incidence is carried out to the 2nd light introduction flat surface (921b) is also a light guide plate (911). Inside is spread and the part is the 2nd salient train (915). Outgoing radiation is carried out from an outgoing radiation side (915b).

[0039] Thus, light guide plate (911) The outgoing radiation light by which shell outgoing radiation is carried out is controlled by the diffused light of 90 degrees of abbreviation. And light guide plate (911) The outgoing radiation light by which shell outgoing radiation is carried out is a prism sheet (991). Liquid crystal panel (101) It is controlled by the light source light of 22 degrees of going converging angles (omega 3).

[0040] As explained above, it is the liquid crystal display (1) of this example. If it depends, it will be the tubular light source (951). Effective viewing area (103) Corresponding light guide plate (911) Since it is contained in the thickness direction, it is a liquid crystal display (1). A dimension is the tubular light source (951). Restrictions cannot be received and, therefore, the miniaturization of equipment can be attained. And light guide plate (911) (806) It is a taper-like and is X drive circuit board (811) to the thin field of the board thickness. Since it is arranged, it is a liquid crystal display (1). Much more narrow picture frame-ization was able to be attained.

[0041] Moreover, the tubular light source (951) Liquid crystal display (1) Since it can detach and attach easily from a rear face or the side, a maintenance is easy. For example, the tubular light source (951) Reflective film (961) It unit-izes and is a light guide plate (911). If it is made removable, exchange of the light source will become easier.

[0042] Moreover, this surface light source equipment (901) Since the converging angle is controlled small, the light source light of a shell has high efficiency for light utilization, and therefore, low-power-ization of equipment can be attained.

[0043] For example, according to this example, compared with the conventional surface light source equipment with which the dispersion pattern was arranged on the light guide plate rear face, the display brightness in a liquid crystal display was fully able to be raised.

[0044] At the example mentioned above, it is the tubular light source (951). Light guide plate (911) As this invention is not limited to this although it explains taking the case of the case where it has arranged to a part for a center section, and shown in drawing 5 (b), it is a light guide plate (911). It may be arranged near the ****.

[0045] Moreover, at the example mentioned above, it is a light guide plate (911). It is a lamp receipt slot (921) to a part for a center section. Although explained taking the case of the case where it has arranged, this is a light guide plate (911). You may penetrate.

[0046]
[Effect of the Invention] According to the surface light source equipment of this invention, efficiency for light utilization is high, and moreover, according to the display using this surface light source equipment, narrow picture frame-ization of equipment can be attained.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing 1 is the outline perspective diagram of the liquid crystal display of one example of this invention.
[Drawing 2] Drawing 2 is the outline cross section of the display cut along with the A-A' line in drawing 1 .
[Drawing 3] drawing 3 -- a part of array substrate of the liquid crystal display of one example of

this invention -- it is outline front view

[Drawing 4] drawing 4 -- some liquid crystal displays of one example of this invention -- it is an outline cross-section perspective diagram

[Drawing 5] Drawing 4 is drawing for explaining the function of the surface light source equipment in one example of this invention.

[Description of Notations]

(1) -- Liquid crystal display
(100) -- Array substrate
(300) -- Opposite substrate
(901) -- Surface light source equipment
(913) (915), -- salient train
(913a) (915a) -- Reflector
(913b) (915b) -- Outgoing radiation side
(951) -- Tubular light source

* NOTICES *

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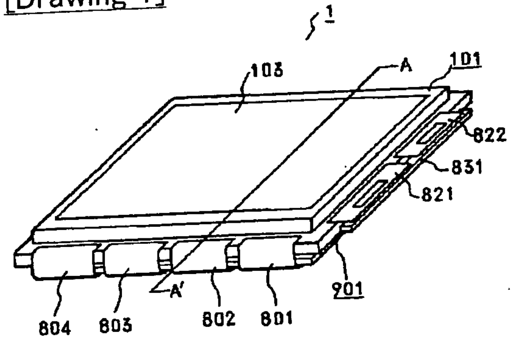
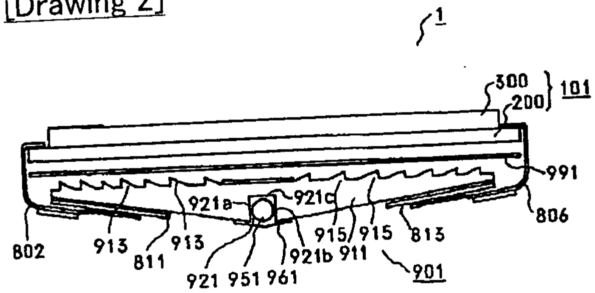
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

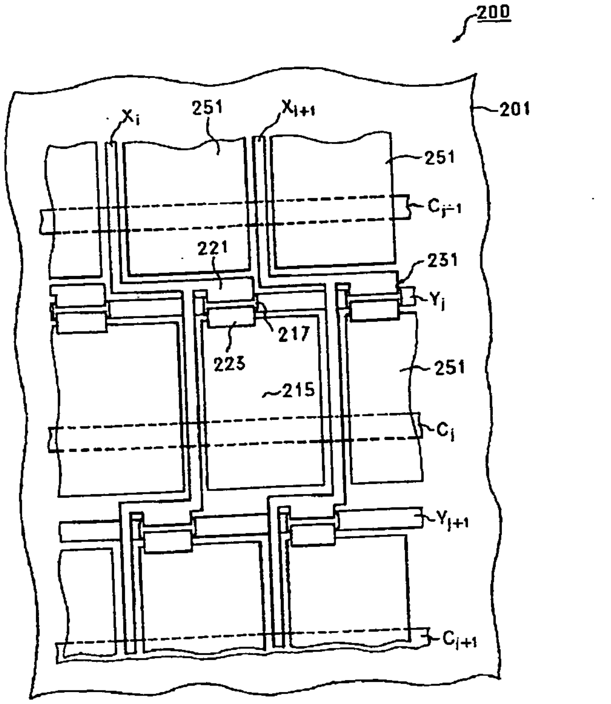
[Drawing 1]



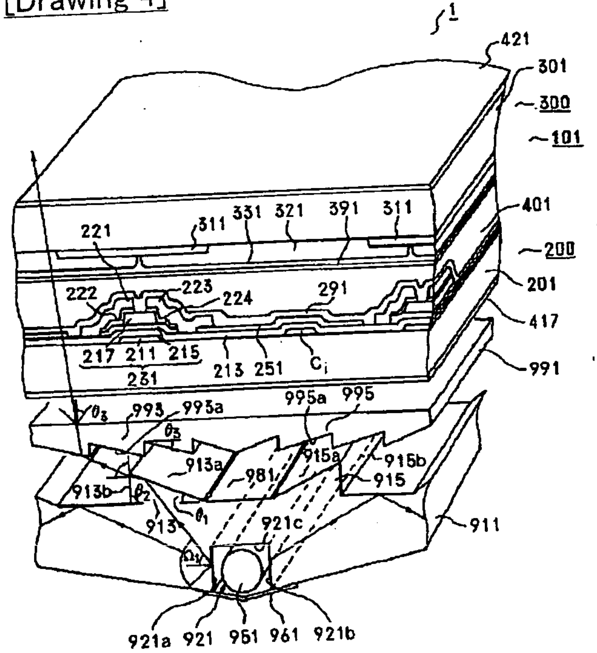
[Drawing 2]



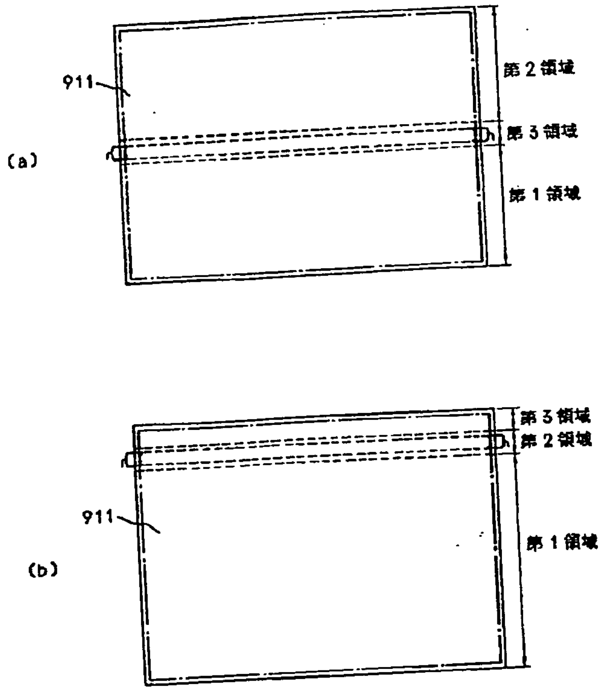
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]